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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/253,306	02/19/1999	DONALD S. GARDNER	042390.P5832	5456

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EXAMINER

TRAN, THIEN F

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 09/23/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

A2C

Office Action Summary	Application No. 09/253,306	Applicant(s) GARDNER ET AL.	
	Examiner Thien F Tran	Art Unit 2811	

-- Th MAILING DATE of this communication appears n th cov r sh t with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 4-6, 9-11, 14-16 and 19-21 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 4-6, 9-11, 14-16 and 19-21 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on ____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on ____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). ____.
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____ 6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 4, 5, 9, 10, 14, and 15 and are rejected under 35 U.S.C. 103(a) as being unpatentable over Shin (USPN 5,665,643 of record) in view of Ryan et al. (USPN 5,243,221) and Ouellet (USPN 5,747,361).

Shin discloses a semiconductor device (Fig. 2) comprising an interconnection structure 22 formed on a substrate 20, the interconnection structure comprises an aluminum copper titanium alloy layer 22c. Shin does not explicitly disclose the aluminum copper titanium alloy layer containing 0.1 atomic percent titanium (same as about 0.18 weight percent titanium), and about 0.5 atomic percent copper. Ryan et al. discloses an interconnection comprising an aluminum alloy layer that contains 0.5 atomic percent of copper (see col. 1, lines 57-62). It would have been obvious to a person having ordinary skill in the art at the time the invention was made to form the aluminum copper titanium alloy layer of Shin having 0.5 atomic percent of copper as taught by Ryan et al. in order to avoid electromigration problems. Ouellet discloses an aluminum alloy layer used as the interconnection layer containing 1.25 weight percent to 0.05 weight percent of titanium (see col. 19, lines 25-50). It would have been obvious to a person having ordinary skill in the art at the time the invention was made to form

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the aluminum copper titanium alloy layer of Shin having about 0.1 atomic percent titanium which is equivalent to about 0.18 weight percent as taught by Ouellet so that the presence of the titanium in the aluminum alloy layer can avoid electromigration problems, prevent the reaction of the metal barrier layer with the aluminum alloy layer, and also keep the titanium content of the aluminum alloy at a minimum to ensure the lowest possible bulk resistivity. As a result, the modified Shin would provide an interconnection comprising an aluminum copper titanium alloy layer 22c having the composition of titanium, copper and aluminum as claimed.

Claims 6, 11, 16, and 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shin (USPN 5,665,643) in view of Ryan et al. (USPN 5,243,221) and Ouellet (USPN 5,747,361) as applied to claims 4, 5, 9, 10, 14 and 15 above, and further in view of Inoue et al. (USPN 5,635,763 of record).

Combined teachings of Shin, Ryan and Ouellet as described in details above further disclose a double-layered structure having a second titanium nitride layer 22b and a second titanium layer 22a under the aluminum copper titanium alloy layer 22c. The modified Shin does not disclose another double-layered structure having a first titanium nitride layer and a first titanium layer above the aluminum copper titanium alloy layer. Inoue et al. discloses a semiconductor device comprising a multilayered interconnection structure (Fig. 3A) formed on a substrate 1, the interconnection structure comprises a double layered structure of a second titanium nitride layer 9 overlying a second titanium layer 21, wherein the double layered structure is formed under an aluminum alloy layer 10; and another double layered structure 32 of a first

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titanium nitride layer 11 overlying a first titanium layer 23 wherein the another double layered structure is formed above the aluminum alloy layer 10. It would have been obvious to a person having ordinary skill in the art at the time the invention was made to incorporate another double-layered structure having a first titanium nitride layer and a first titanium layer above the aluminum copper titanium alloy layer 22c of the modified Shin as taught by Inoue et al. in order to suppress the migration of aluminum atoms and thus improve the electromigration performance of the interconnection. The TiN/Ti double layered cap also has an excellent reflection suppressing effect and reduce the contact resistance.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thien F Tran whose telephone number is (703) 308-4108. The examiner can normally be reached on 8:00AM - 4:30PM Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

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September 20, 2002

A handwritten signature in black ink, appearing to read "Thien Tran".

Thien Tran
Patent Examiner
Technology Center 2800